CHEMICAL EVALUATION OF SOME EDIBLE MUSHROOM SPECIES CULTIVATED IN RURAL GARDENS IN EDO STATE, NIGERIA

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ABSTRACT

Fresh samples of edible mushrooms - Volvariella volvacea, Pleurotus tuberregium and Pleurotus djamor – were collected from some home gardens in which the mushrooms were cultivated on decayed wood shavings from sawmills in Oluku, Benin-City, Edo state. These were harvested weighed and oven dried. The dried samples were milled and examined by chemical analyses for their proximate, minerals and phytochemical compositions. The results indicated appreciable amounts of essential nutrients in the mushroom species. Pleurotus tuberregium was the richest in protein content (41.32%) and highest moisture content (22.23%). P. djamar was rich in fat (15.63%), calcium (38.50mg/g), sodium (3.03mg/g) and magnesium (18.98mg/g). V. volvacea contained the highest value of ash content (14.05%) and carbohydrate (19.65%), while P. tuberregium was rich in crude fibre (6.75%) and potassium (7.25mg/g). The study confirmed that mushrooms have a higher levels of proteins than most leguminous plants and vegetables hence, could serve as substitutes for food legumes, meat or fish in food recipes. Phytochemical studies confirmed the presence of saponins, flavonoids, tannin, phenolic compounds and alkaloids in Volvariella volvacea, Pleurotus tuberregium and Pleurotus djamor. The charsterization of these phytocompounds in the mushrooms is recommended. show that they should be added in our daily meal due to their health benefits.

Keywords: *Edible mushrooms, cultivated, home gardens, chemical composition*

INTRODUCTION

Since time immemorial, mushrooms have been in use as food, because they are considered as important food resource in human diet! And currently, the cultivation and production of edible mushrooms are on the increase globally. Many studies, reported on the chemistry and nutrient components of different mushroom species, indicated that cultivated and wild mushrooms, contain appreciable amounts of proteins, carbohydrates, minerals, fibers and vitamins, while they contain low levels of calories, sodium, fats and cholesterol (Barros *et al*, 2008; Aida *et al*, 2009). The nutritional value of high-grade mushrooms was reportedly almost equivalent to that of milk while their phytochemical components, have medicinal value; some as strong antioxidants, with no undesirable side-effects, while promoting the health of the consumer (Liu, 2004; Adebayo *et al*, 2012; Egwim *et al*, 2011; Reis *et al*, 2012).

In Nigeria, the consumption of edible mushrooms in the country is seasonal! For the most, mushrooms are searched for and harvested from the wild by those who relish them because of their unique flavor rather than knowledge of their nutritional value (Okhuoya and Okogbo, 1991; Ijeoma *et al*, 2015). However, there is increasing awareness of the nutritional and economic potential of edible mushrooms, among rural communities in the country; and presently there are attempts to cultivate some edible wild species in rural and home gardens, and to promote their commercialization! Nonetheless, information on their chemical composition, particularly the phytochemical properties of the wild edible species, is scanty. This study was thus conducted on that premise, to ascertain the nutritional potentials of three promising edible mushroom species, *Volvariella volvacea, Pleurotus tuberregium* and *Pleurotus djamor*, cultivated in Edo State, and processed in different forms for use as food or feeding stuff. The objectives were to determine by chemical analysis, the proximate compositions, mineral contents and phytochemicals in raw, boiled, sundried and oven-dried mushrooms species sampled from different rural and home gardens located within the State.

MATERIALS AND METHODS

Collection and preparation of the samples for proximate analyses

Pleurotus tuberregium was harvested from a cultivated mushroom garden, located at Grace complex, in Isiohor quarters. The other mushroom species were collected from a sawmill dump in Oluku quarters. Both quarters are suburbs in the western axis of Benin-City, Edo state! And the

mushroom species could be found growing abundantly in those locations. Fresh samples were harvested, cleaned, weighed and wrapped in a foil paper and then oven-dried at 105^{O}C for 24 hours to attain a constant dry weight. The dried samples were milled separately, and packaged in an air tight sample pouches, zipped and labeled, then kept in cool dry place until required for laboratory analyses.

Moisture Content and Dry Matter Determination

Portions (5g) of each fresh sample were weighed into a previously weighed foil paper. The foil paper with the sample was then placed in the oven at 105 °C for 24 hours. The samples were then removed, placed in desiccators to cool and then weighed. The samples were then put back in the oven and the process repeated until a constant weight was obtained. Moisture content() was thus calculated as follows**:-**

$$\% \text{ Moisture} = \frac{\text{Loss of weight}}{\text{Weight of sample}} \times \frac{100}{1}$$

100 – Moisture content = Dry matter content.

Crude Protein

Two gram (2g) portions of each sample were transferred to a Kjedhal flask. Then 20ml of conc. sulphuric acid (H_2S0_4) and 1g of selenium catalyst were added. The solution was digested by heating over mantle placed in fume cupboard, until it became colorless. Digest was removed from heat, cooled and water was added to dissolve all solids. The process converted protein nitrogen to ammonia in the form of ammonium sulfate. Thus the digest was transferred to distillation apparatus and then 20mls of 40% sodium hydroxide (NaOH) was added to the digest to liberate and distil off the ammonia; and this was collected into a flask containing 5ml of boric acid in the presence of litmus indicator. Distillate thus collected was back-titrated to grey point with sulfuric acid; and the value recorded was used to calculate the percentage nitrogen. Based on the assumption that the nitrogen content of protein is 16%, the crude protein (CP) content of sample was computed by multiplying nitrogen content determined by the classical factor (6.25), based on the following equations and calculations:-

Stage 1: $(-NH_2) + H_2S0_4 \longrightarrow (NH_4)_2S0_4 + CO_2 + O_2$

Stage 2: $(NH_4)_2S0_4 + NaOH \longrightarrow NaS0_4 + 2NH_3 + H_2O$

Stage 3: $2H_3B0_4 + 2NH_3 \longrightarrow 2NH_4H_2B0_4 + H_2S0_4 \longrightarrow (NH_4)_2S0_4 + 2H_3B0_4$

$\%N = V_A \times V_F \times MW_N / 100\ Ws \times aliquot.\ \ \%CP = \%Nr \times 6.25$

Where: V_A - volume of acid used in titration, V_F - volume of volumetric flask used for digestion. MW_N - molecular weight of nitrogen (0.00014), Ws - weight of sample

Ash Content

Two (2g) of sample was measured into a previously weighed and ignited crucible, then placed in muffle furnace and heated at 560° C for 6 hours to ash indicating combustion of the organic matter in the original sample. Following, the residue (ash) was removed from the furnace, cooled in a dessicator and weighed. The ash content is expressed thus: Weight of ash/Weight of sample x 100/1.

Ether Extract

Fats and fatty substances are characterized by their solubility in the series of organic solvents and this phenomenon was utilized in determining the lipid content of the various samples, crude lipid was determined following extraction with petroleum ether as solvent in soxhlet extractor. Then the solvent was distilled off and the residue was dried for a period over 30 mins in a vacuum oven set at 72° C. Following, residue was cooled, dessicated and weighed. The drying and weighing processes were repeated severally until a constant weight was attained. Thus ether extract (EE) content of sample was calculated using this equation: %Ether extract = Weight of oil / Weight of sample x 100 /1

Nitrogen Free Extract

This comprises the soluble carbohydrate component of organic matter in each sample was determined by arithmetic: the summation of the values of ash, crude protein, ether extract and crude fiber components of the samples; and subtraction of this sum from the total dry matter content of sample - % NFE= % DM - % (CP + Ash + EE). The NFE value usually an approximation because it includes

the cumulative errors of the other determinations was thus also expressed as a proportion of total dry matter (DM).

Analysis for minerals

Total phosphorus content in each sample was determined spectro-photometrically by the phospho-vanado-molybdate method (AOAC, 2010) using the Atomic Absorption Spectrophotometer, AAS - Buck Scientific, Model - 210, equipped with single slot burner and air acetylene flame. Phosphorus stock standard containing 2000g of phosphorus per liter of stock standard solution was prepared by dissolving 1.1224 g of dibasic potassium phosphate (K_2HPO_4; M.Wt. = 174) in 500 ml de-ionized water, acidified with 8ml concentrated HCl before diluting to 1000 ml in a 1-litre volumetric flask. A 25 ml portion of the stock standard was diluted to 100 ml with 10 % trichloro-acetic acid solution to give a working solution which was further diluted to concentrations (P) of 0.005 mg / ml, 0.10mg/ml, 0.15 mg/ml, 0.20 mg/ml and 0.50 mg/ml. The absorbance values were read from the AAS set at 660nm wavelengths and then plotted against the concentrations to produce the standard curve from which the concentration of phosphorus in the samples at known absorbance was extrapolated.

Analyses of other minerals (sodium, potassium, calcium, iron, magnesium, selenium and zinc) were performed using the wet digestion and spectrophotometry method (AOAC, 2010). The AAS, model - A. Analyst 300, Perkin Elmer, Morwalk, Conn, USA, was used. Working standard solutions were first prepared for each element from stock standard solutions containing 1000 ppm of each element in 2N HNO_3 solution. Calibration and measurement of absorbance of each element against a blank, at its unique wavelength was read using the AAS. The calibration curves were drawn separately for each element.

Digestion of samples: Ground samples (0.5g) of each mushroom species were boiled (100° C) with 5 ml concentrated nitric acid (HNO_3) and 5 ml of 30 % hydrogen peroxide (H_2O_2) solution continuously for about 2 hours in an electric heating mantle (HP 220, LITEC Product Inc. Albany, N-Y., USA) until clear solutions were obtained. These were cooled, filtered, first through Whatman no. 45 filter papers and then through < 0.45 millipore filter papers. Filtrates were made up to mark with distilled water in 25-ml volumetric flasks, capped and shelved. From these aliquots were taken for AAS analysis of the different minerals in the samples.

Sample reading: The absorbance of sample aliquots were read at specific wavelength set for each element from the spectrophotometer; and then the concentration of the element in each of the mushroom samples were extrapolated from the standard curve.

Determination of Phytochemicals

Preparation of mushroom extract: Preparation of sample extract was undertaken in accordance with standard procedure (Harborne 1998; Adebayo and Ishola, 2009). The mushroom powdered was weighed accurately to 1g and the same was filled in thimble and placed in the central assembly of the reflux apparatus with measured 50ml of methanol and 50 ml of distilled water separately to form extract in methanol and water respectively. The extraction was done in this apparatus at 100 ^{0}C for 6 hours. After the completion of the extraction, the supernatant was filtered through whatman No.1 filtered paper. All solvent extracted fractions were evaporated to dryness to obtained residue. The extracts were stored in an air tight container until required for test.

Test For Saponin: 5ml of the extract was vigorously shaken with 8ml of distilled water in a test tube for 30 seconds and was left undisturbed for 20 minutes. Persistence frothing indicated the presence of saponin.

Test for Tannin: 2 grams of samples were weighed and mixed with 10 ml of distilled water. The mixture was filtered and 2 drops of 5% ferric chloride ($FeCl_3$) were added to the filtrate. Blue-black color formation shown, indicated the presence of Tannin.

Test for Alkaloid: 2 grams of samples were weighed in a beaker and it was extracted with 10 mls of 2% hydrochloric acid (HCl) by heating gently for about 5 minutes, the HCl extract was filtered with Whatman No.1 filter paper to have a clear solution and prevent false result. Then 2.55 ml of filtrate obtained was treated with few drops of Dragendoff's reagent. Appearance of precipitate indicated the presence of Alkaloid in the extract

Test for Flavonoid: 5 milimetre of diluted NH_3 solution were added to a portion of aqueous filtrate of sample extracts for by the addition of concentrated sulphuric acid. Formation of yellow colour indicated the presence of flavonoid.

Test for Phenolic compound: Few drops of neutral 5% ferric chloride solution were added, a dark-green color indicated the presence of phenolic compounds

Statistical Analysis: Variance analysis was performed for the data obtained from measurements. Means were separated and compared by

Duncan's Multiple Range Test (Duncan, 2000).

Results

Proximate composition of edible mushrooms

The results of proximate analyses showed that *Pleurotus tuberregium* had the highest moisture content (MC) value of 22.23%, compared to *Vovariella volvacea* which recorded the lowest MC (Table 1). *P. tuberregium* recorded the lowest ash content while *V. volvacea* recorded the highest ash value (14.05%). The lowest crude protein content (CP), 36.36%, was measured in *V. volvacea* whereas *Pleurotus djamor* measured 38.37% CP and *P. tuberregium* contained the highest CP value- 41.32%. The crude fiber (CF) content of *V. volvacea* was 5.70% compared to 6.08% found in *P. djamor;* while *P. tuberregium* recorded 6.57% CF. The highest ether extract content - 15.63% EE, was recorded for *P. djamor* while the lowest value - 11.30%, was found in *V. volvacea*. The highest value of Nitrogen free extract (NFE) was recorded for *V. volvacea* while *P. tuberregium* had the lowest NFE content - 4.65% (Table 1).

Table 1: Proximate composition of *Pleurotus tuberregium, Pleurotus djamor* and *Vovariella volvacea* (g/100g DM)*

	M.C	Ash	CP	CF	EE	NFE
Volvariella Volvacea	12.94	14.05	26.36	15.70	11.30	19.65
Pleurotus djamor	16.03	12.94	28.37	16.08	15.63	10.91
Pleurotus Tuberregium	22.23	12.03	31.32	16.57	13.20	4.65

KEY: *MC-moisture content, CP- crude protein, CF- crude fiber, EE- ether extract, NFE- nitrogen free extract*

**Values represent means of three replicate determinations*

Mineral Composition of edible mushrooms

The analyses of mineral elements in the mushroom species showed that *Pleurotus tuberregium* had the highest concentrations (mg /100g DM) of calcium, sodium and potassium which were 48.50, 3.59 and 7.25 respectively; while *Vovariella volvacea* recorded the lowest values in calcium, sodium and potassium contents which were 37.15, 1.58 and 2.62 mg /100g DM respectively (Table.2). The highest value of magnesium, 25.22 mg /100g DM, was found in *V. volvacea* while *Pleurotus djamor* recorded the lowest Mg content of 18.98 mg /100g DM.

Table 2: Mineral composition of edible mushrooms (mg/100gDM)*

	Calcium	Sodium	Potassium	Magnesium
Pleurotus tuberregium	40.25	3.59	7.25	20.75
Pleurotus djamor	38.50	3.03	4.48	18.98
Vovariella volvacea	37.15	1.58	2.62	25.22

**Values represent means of three replicate determinations*

Phytochemical components of edible mushrooms

The results of phytochemical analyses showed that there were no alkaloids in both the aqueous and methanolic extracts of *Pleurotus tuberregium.* while alkaloids as well as flavonoids were present in the two solvent extracts of *Pleurotus djamor* (Table 3). For *Volvariella volvacea*, alkaloids, were only present in methanol extract and absent in aqueous extract. Flavonoids and tannins were present in methanolic and aqueous extracts in *Pleurotus tuberregium* whereas phenolic compounds present only in methanolic extract and absent in aqueous extract of *P. tuberregium*. Saponin was present in aqueous extract and absent in methanol extract of both *P. tuberregium* and *Pleurotus djamor*. The methanol extract of *P. djamor* showed the presence of phenolic compounds and tannins while none were found in the aqueous extract. Tannins and phenolic compounds were both present in methanol and aqueous extracts of *V. volvacea* while saponin and flavonoids were not detected in the two solvent extracts (Table 3).

Table 3: Phytochemicals in aqueous and methanol extracts of *Pleurotus tuberregium, Pleurotus djamor* and *Volvariella volvacea*.

Phytochemicals	Mushroom species					
	Pleurotus tuberregium		*Pleurotus djamor*		*Volvariella volvacea*	
	Methanol	Aqueous	Methanol	Aqueous	Methanol	
Aqueous						
Alkaloids	-	-	+	+	+	-
Flavonoids	+	+	+	+	-	-
Phenolics	+	-	+	-	+	+
Compounds						
Saponin	-	+	-	+	-	-
Tanin	+	+	+	-	+	+

*Note * (+) presence and (-) absence*

Discussion

Mushroom species are many and varied in structure and chemical composition! More than 140,000 species of mushrooms exist in nature, but less than 25 species (including *Agaricus bisporus, Pleurotus tuberregium .pleurotus djamor, Lentinus edodes, Volvariella volvacea, Auricularia spp.*) are widely accepted as food and only a few have attained the level of an item of commerce (Bonatti *et al*, 2004; Wasser, 2007). They are macroscopic fungi with distinctive fruiting bodies which can be hypogeous or epigeous, large enough to be seen and picked by hands! Both edible and poisonous types, grow in various places, including wet environments, on decayed plants and animal sites, termite nests, palm wastes, leaf litters, and under shades (Gan *et al*, 2013; Udu-Ibiam, *et al*, 2014). Hence mushrooms can be easily cultivated with minimum agronomic input.

The edible mushrooms have gained worldwide recognition and increasing popularity owing to their nutritional and medicinal values since ancient Greece and Roman empires (Gan *et al*, 2013). Barros *et al* (2008) reported that the wild mushrooms offered richer sources of protein and lower amounts of fat than commercial mushrooms! The wild mushroom proteins also contain considerable amounts of non-essential amino acids (alanine, arginine, glycine, glutamic acid, aspartic acid, proline and serine), which are important in building the structures of cells, tissues and organs; and therefore essential for growth and repair (Beluhan and Ranogajec, 2011). Due to their high

content of vitamin, protein and mineral, mushrooms such as *Calocybe indica*, *Russula delica*, *and Lyophyllum spp*, were recommended as cheap sources of protein particularly for the poor and low income earners! Of interest also was the reference to mushrooms found in the Vedas which indicated that the Greeks and Romans considered mushrooms as `Food for the gods` which they served only during celebrations (Ferreira *et al*, 2009).

The results of this study, corroborate evidence that many genera of mushrooms are edible, and generally possess most of the attributes of nutritious food as they are rich in essential nutrients - carbohydrates, proteins, vitamins, mineral, fat, fiber and various amino acids. Kalac (2009) indicated that as at 1978, the Food Agriculture Organization (FAO) published a crude protein (CP) content of 3.7% for fresh mushroom. In this study, we found a significantly high protein content which varied between 26.36 and 31.32 %. Some previous reports showed that the CP of mushrooms varied according to the genetic structure of the species, and the physical and chemical differences of the growing medium (Sanme *et al*, 2003). In addition this result is in agreement with some published studies which indicated that the protein content of edible mushroom such as *Pleurotus djamor* and *Pleurotus tuberregium* have twice the CP content of onion (14%), cabbage (1.4%), potatoes (1.6%), and four to six times that of oranges (1.0%) and apple (0.3%). Therefore, in terms of the relative amount of crude protein, mushroom rank above the aforementioned vegetables and cereal foods (Ola and Oboh, 2001).

Nutritionally important minerals such as calcium, potassium, magnesium and sodium are required for various roles, including transmission of nerve impulses, rigid bone formation and regulation of water and salt balance, repairing worn-out cells, strong bone and teeth, building blood cells and maintaining osmotic balance (Olomu, 2011). The presence of these elements in the three mushrooms species examined has been confirmed in this study! They showed high levels of calcium and magnesium, and appreciable levels of sodium and potassium. This agreed with the reports on mineral content of *Pleurotus ostreatus* and some cultivated mushrooms (Aletor, 1995; Barros *et al*, 2008). However we observed low concentrations of sodium and potassium in *V. volvacea*, while it showed higher amounts of magnesium, compared to the *Pleurotus spp.*

In this study, high fiber content obtained for *Pleurotus tuberregium* (6.57%) which compared favorably

with values earlier reported by Zang *et al*, (2001). Also we observed relatively high carbohydrate contents recorded in *Vovariella volvacea* (Table 1). This was a proof of the high food value of mushrooms; corroborating the previous reports and the evidence that mycoproteins and mushrooms shared similar values in their nutrient composition. The fat contents obtained (11.30 to 15.63%), especially for *Pleurotus djamor* was higher than those reported by Kalac **(**2009, 2012**)**.This points to the potential of these mushroom species as source of oils and fatty acids.

The presence of essential nutrients and minerals in the wild edible mushrooms imply that they can be utilized to improve nutrition and health. Many people relish edible mushrooms because of their flavor, meaty taste and medicinal value. They have high nutritional value particularly as a good source of protein that can enrich human diets or to combat malnutrition, especially in some developing countries where animal protein may not be available and/or are expensive (Aletor, 1995). The high moisture content (12.36 to 22.23%) found in the mushrooms examined in this study, is an indication that like vegetables, fresh mushrooms are highly perishable, and cannot be kept for a long time, as high water activity enhances microbial growth (Aletor, 1995). However there is the possibility of dehydrating the fresh product to produce mushroom powder which can be stored for long period (Odafe, 2017).

The phytochemical analyses of the edible mushrooms showed that they contain bioactive compounds are known to play a vital role in promoting health (Table 3). *Pleurotus tuberregium, Pleurotus djamor* and *Vovariella volvacea* disclosed the presence of major phyto-constituents viz., alkaloids, saponins, steroids, phenols and flavonoids. *Pleurotus djamor* seemed vastly rich in phytochemicals tested for – aqueous extract showed presence of saponin where methanol extracts didn't. *Volvariella volvacea* showed least amounts of phytoconstituents, as it lacked in both flavonoids and saponin. Tannins and saponins like those found in *Pleurotus tuberregium and Pleurotus djamor,* are econmically important phyto-compounds, having potential medicinal value! Saponins are exploited in food, medicinal and pharmaceutical industry due to its frothing effect and foaming ability! Tannins are compounds which have been found to possess astringent properties, which hasten the healing of wounds and inflamed mucous membrane (Okwu, 2004). The powerful effects of alkaloids in animal physiology and pharmacology was demonstrated by

Edeoga and Eriata (2001) who showed that alkaloids and their synthetic derivatives could function as analgesic, antispasmodic and bactericidal agents. Phenols are useful as they form the main constituents of most antiseptics and disinfectants. Thus the antifungal, antiseptic and therapeutic properties of some mushrooms species may be due to the phenols they contain (Ehsann and Saadabi**,** 2012).

Generally, phytochemicals are bioactive compounds! They are borne in plants as protective agents against environmental pests and diseases to ensure species survival; but also as nutraceuticals! That means upon ingestion at optimal levels, they work with nutrients and dietary fiber to protect animals and humans against degenerative or infectious diseases; and hence are potentially useful in human welfare programs (Barros *et al*, 2008**;** Odafe, 2017). For example, *Pleurotus spp* (e.g. *P. florida*) has antioxidant and antitumor activities! Reports indicated that mushrooms contain antioxidants or phenolic compounds that have excellent antioxidant properties and synergist that is not mutagenic (Fereirra *et al*, 2009; Gan *et al*, 2013). Antioxidants such as flavonoids prevent oxidative damage related to aging and diseases, such as atherosclerosis, diabetes, cancer and cirrhosis (Liu, 2004; Odafe, 2017). The presence of flavonoids in *Pleurotus spp* was confirmed in this study. This implies that the consumption of Pleurotus should be recommended to reduce oxidative damage in humans; as this would tend to increase antioxidant enzyme activity as well as anticancer activity (Liu, 2004; Odafe, 2017). Exogenous sources of free radicals include tobacco smoke, ionizing radiation, certain pollutants, organic solvents and pesticides. They are capable of attacking the healthy cells of the body, causing them to lose their structure and function. In comparison, mushrooms can represent the main endogenous sources of antioxidants, scavenging the free radicals and the oxidants produced by cells (Subbulakshmi and Kannan, 2016).

Plants have limitless ability to synthesize aromatic secondary metabolites, most of which are phenols or their oxygen substituted derivatives, such as phenolic acids, flavones, flavonoids, flavonols, quinines, tannins and coumarins. In fact, mushrooms accumulate a variety of such secondary metabolites, including phenols, polyketides, terpenes, steroids and alkaloids! And some of these compounds are poisonous and may be fatal within few hours after ingestion (Kalac, 2009; 2012). However, many of such compounds are borne as antimicrobial agents; and serve as plant defense mechanisms against pathogenic

microorganisms (Iwalokun et al, 2007; Javale and Sabnis, 2010; Adebayo *et al*, 2012; Ijeoma *et al*, 2015). Reports on *in-vitro* studies, indicated that flavonoids and saponins extracts from plants exhibited better inhibitory effects on micro-organisms, than the effects shown by extracted phenols (Javale and Sabnis, 2010). The reason adduced was that unlike phenols, flavonoids and saponins were synthesized by the plants as antagonists, in response to microbial infection.

It is important to emphasize that although there are over 300 genera of mushrooms and related fleshy basidiomycetes, only a few species of these fungi are cultivated commercially. The reason is because many of them are mycorhizal and may not sporulate in the absence of the host. However, around the world, many saprophytic species have been amenable to cultivation! Some of the more common cultivated species are the button mushroom, *Agaricus bisporus* which was widely cultivated in Europe before being exported to North America by the settlers; the Shiitake mushroom (*Lentinus edodes*) which is grown for centuries in China and other oriental countries and the oyster mushroom (*Pleurotus ostreatus*) which was collected as wild specimens from forests in Florida and later actively cultivated in several countries around the world. There are also the oriental Enoke or velvet stem mushroom (*Flammulina velutipes*) whose major production is in Japan; the paddy straw mushroom (*Volvariella volvacaea*) and ear fungus (*Auricularia auricula*) which has great medicinal value. Moreover, the Reishi mushroom (*Ganoderma lucidum*) is cultivated in Japan and is used as an alternative medicine and also as flavoring agent in Japan; the Nameko (*Pholiota nameko*) grown in the orient and *Tremelia fuciformis* or white jelly fungi that is grown for use as food supplements in Taiwan. Varieties of *A.bisporus* that are grown commercially include the crimini and portabello. Truffles (*Tuber spp*) live in close mycorhizal association with roots of specific trees. They are considered a food delicacy and rated as one of the most expensive natural food in the world (Trappe *et al*, 2007; Bipasha 2011). In Nigeria both rural and commercial farming of *Volvariella volvacea, Pleurotus tuberregium* and *Pleurotus djamor* mushrooms are on steady increase in many places across the country.

Conclusion and Recommendations

This study sought to determine the proximate and mineral compositions of *Volvariella volvacea, Pleurotus tuberregium* and *Pleurotus djamor* mushrooms; evaluate by qualitative analysis the phytochemicals components. The analyses indicated

that the mushroom contain higher than 20% crude protein (CP) which confers on them the nutritional attributes of a classical protein source. The CP values obtained for the mushrooms than percentage CP found in many legume grains and vegetables. Hence, edible mushroom can be exploited as substitute for expensive meat and fish in developing nations. Mushrooms portend additional benefits in promoting health! Wild edible mushrooms apart from being used as food can be used as antibacterial agent as well as in the development of new drugs to combat the harmful activities of excess free radicals in humans. However, care should be taken to differentiate edible mushrooms from poisonous ones in the wild before consumption! A study in this regard is thus recommended.

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